U.S. FISH AND WILDLIFE SERVICE
SPECIES ASSESSMENT AND LISTING PRIORITY ASSIGNMENT FORM

SCIENTIFIC NAME: *Megalagrion oceanicum*

COMMON NAME: Oceanic Hawaiian Damselfly

LEAD REGION: Region 1

INFORMATION CURRENT AS OF: September 2005

STATUS/ACTION:

____ Species assessment - determined species did not meet the definition of endangered or threatened under the Act and, therefore, was not elevated to Candidate status

____ New candidate

__X_ Continuing candidate

____ Non-petitioned

__X_ Petitioned - Date petition received: May 11, 2004

____ 90-day positive - FR date:

__X__ 12-month warranted but precluded - FR date: May 11, 2005

_N__ Did the petition request a reclassification of a listed species?

FOR PETITIONED CANDIDATE SPECIES:

a. Is listing warranted (if yes, see summary of threats below)?

b. To date, has publication of a proposal to list been precluded by other higher priority listing actions?

c. If the answer to a. and b. is "yes", provide an explanation of why the action is precluded. We find that the immediate issuance of a proposed rule and timely promulgation of a final rule for this species has been, for the preceding 12 months, and continues to be, precluded by higher priority listing actions. During the past 12 months, most of our national listing budget has been consumed by work on various listing actions to comply with court orders and court-approved settlement agreements, meeting statutory deadlines for petition findings or listing determinations, emergency listing evaluations and determinations and essential litigation-related, administrative, and program management tasks. We will continue to monitor the status of this species as new information becomes available. This review will determine if a change in status is warranted, including the need to make prompt use of emergency listing procedures. For information on listing actions taken over the past 12 months, see the discussion of "Progress on Revising the Lists," in the current CNOR which can be viewed on our Internet website (http://endangered.fws.gov).

____ Listing priority change

Former LP: ____

New LP: ____

Date when the species first became a Candidate (as currently defined): 11/15/1994

____ Candidate removal: Former LP: ____

___ A – Taxon is more abundant or widespread than previously believed or not subject to

the degree of threats sufficient to warrant issuance of a proposed listing or continuance of candidate status.

___U – Taxon not subject to the degree of threats sufficient to warrant issuance of a proposed listing or continuance of candidate status due, in part or totally, to conservation efforts that remove or reduce the threats to the species.

___ F – Range is no longer a U.S. territory.

___ I – Insufficient information exists on biological vulnerability and threats to support listing.

___ M – Taxon mistakenly included in past notice of review.

___ N – Taxon does not meet the Act's definition of "species."

___ X – Taxon believed to be extinct.

ANIMAL/PLANT GROUP AND FAMILY: Insects; Family Coenagrionidae (damselfly)

HISTORICAL STATES/TERRITORIES/COUNTRIES OF OCCURRENCE: Hawaii, island of Oahu

CURRENT STATES/COUNTIES/TERRITORIES/COUNTRIES OF OCCURRENCE: Hawaii, island of Oahu

LAND OWNERSHIP
This species is presently known from seven perennial streams on State lands located above 100 m (300 ft) within the Koolau Mountains on the island of Oahu.

LEAD REGION CONTACT: Paul Phifer (503) 872-2823, paul_phifer@fws.gov

LEAD FIELD OFFICE CONTACT: Pacific Islands Fish & Wildlife Office, Lorena Wada, (808) 792-9400, lorena_wada@fws.gov

BIOLOGICAL INFORMATION
Species Description: The oceanic Hawaiian damselfly (*Megalagrion oceanicum*) is a large and robust species. The adults measure from 47-50 millimeters (mm) (1.8-1.9 inches (in)) in length and have a wingspan of 51-55 mm (2.0-2.2 in). Both sexes exhibit prominent patterns including stripes, but males are red in color and females are pale green. Immatures of this species are large in size and exhibit long grasping legs and dagger-like gills (Asquith & Polhemus 1996).

Taxonomy: The oceanic Hawaiian damselfly was first described from the Waianae Mountains of Oahu by R. McLachlan (1883), and this species is recognized as a distinct taxon. McLachlan is the most recent and accepted work up of the taxonomy of this species.

Habitat: Immature stages of this species are found in swiftly flowing sections of streams, usually amid rocks and gravel in the tailraces of riffles and small cascades. While capable of swimming, the naiads usually crawl among gravel or submerged vegetation. Older naiads frequently forage out of the actual stream channel and have been observed among wet moss on rocks, and wet rock walls and seeps (Williams 1936). Adults are very bold and strong flyers, and when disturbed

frequently fly upward into the forest canopy overhanging the stream (Williams 1936; Polhemus 1994a).

Historic and Current Range/Distribution: The oceanic Hawaiian damselfly is endemic to the island of Oahu. Historically it occurred in both the Koolau and Waianae mountain ranges, and was known from the following localities: Haleauau Stream (Williams 1936), Waianae Mountains (Polhemus 1994a), Hering Spring stream (Williams 1936), Honolulu, Kahamainui Gulch, Kalihi Valley, Kawailoa Stream, Manoa Stream, Moanalua Valley, Palolo Stream, Poamoho Trail, Punaluu, Pupukea, Waiahole Stream, Waianae, and Waimanalo (Polhemus 1994a). This species appears to be extirpated from the Waianae Mountains and all leeward drainages of the Koolau Mountains. It is presently known only from seven perennial streams on State lands above 100 meters (m) (300 feet (ft)) within the windward Koolau Mountains at the following localities: Kahamainui (Polhemus 1994b), Kaipapau (Englund and Polhemus 1994), Kaluanui above Sacred Falls (Polhemus 1994b), Koloa Gulch (Asquith 1995), Maakua Gulch (Englund and Polhemus 1994, Polhemus 1994b), Makaua Stream (Asquith 1995), and Waihee Stream (Polhemus 1994b).

THREATS:

A. The present or threatened destruction, modification, or curtailment of its habitat or range. Freshwater habitats on all the main Hawaiian Islands have been severely altered and degraded because of past and present land and water management practices including agriculture, urban development, development of ground water, perched aquifer and surface water resources (USFWS 1985, 1995; Harris *et al*. 1993; Meier *et al*. 1993).

Extensive modification of lentic (standing water) habitats in the Hawaiian Islands began about 1100 AD with a rapid population increase among native Hawaiians (Kirch 1982). Hawaiians cultivated taro (*Colocasia esculenta*) by creating shallow, walled ponds called loi, in marshes and riparian areas (Handy and Handy 1972). By 1778, virtually all valley bottoms with permanent stream flow and most basin marshes were converted to irrigated taro cultivation (Handy and Handy 1972). Hawaiians also modified wetlands by constructing fishponds, many of which were primarily fresh water, fed by streams or springs (Summers 1964). Despite this habitat modification by early Hawaiians, many areas of extensive marsh land remained intact and were utilized by the native damselflies.

Eventually, many of the wetlands formerly used for taro or rice were drained and filled for dry-land agriculture (Stone 1989; Meier *et al*. 1993). Most urban, residential and resort development in Hawaii has occurred in the coastal plains and as a result, many freshwater lentic habitats have been negatively affected (USFWS 1985). By 1990, the Service estimated that 30 percent of all coastal plain wetlands in Hawaii had been lost to agriculture and urban development (Ernie Kosaka, USFWS, *in litt*. 1990), and if only freshwater habitat was considered the loss would be proportionately much higher, probably approaching 80 to 90 percent. Low elevation wetlands are now estimated to be 75 percent lost or significantly degraded (Terrell Ericson, U.S. Department of Agriculture, Honolulu, pers. comm. 2004).

While intentional filling of freshwater wetlands with open water is rarely permitted today (Gordon Smith, USFWS, pers. comm. 2004), loss of smaller areas utilized by damselflies, such as narrow strips of freshwater seeps within anchialine pool complexes, and loss of emergent vegetation still occurs. In addition, marshes are slowly filled and converted to meadow habitat due to increased sedimentation resulting from increased storm water runoff from upslope development, and blockage of downslope drainage (Wilson, Okamoto and Associates, Inc. 1993).

Presently the most significant threat to the remaining natural ponds and marshes in Hawaii is the nonnative species, California grass (*Brachiaria mutica*). The area of origin of this sprawling perennial grass is unknown, but it was first noted on Oahu in 1924 and now occurs on all the major islands (O'Connor 1990). This plant forms dense, monotypic stands that can completely eliminate any open water by layering of its trailing stems (Smith 1985). The most extensive remaining marsh system on the island of Oahu, Kawainui, is now almost entirely choked with California grass, facilitating its conversion to meadowland (Wilson, Okamoto and Associates, Inc. 1993). The James Campbell and Pearl Harbor National Wildlife Refuges on Oahu and Kakahaia National Wildlife Refuge on Molokai must be constantly managed to control this plant (Mike Silbernagle, USFWS, pers. comm. 2004).

Similar to the loss of wetlands in Hawaii, the loss of streams has been significant and began with the early Hawaiians who modified stream systems by diverting water to irrigate taro. However, these Hawaiian-made diversions were closely regulated and were not allowed to take more than half the stream flow, and diversions were typically periodic to flood taro rather than continuous (Handy and Handy 1972).

The advent of plantation sugarcane cultivation in 1835 led to more extensive stream diversions. These systems were typically designed to tap water at upper elevations (> 300 m (984 ft)) by means of a concrete weir in the stream. All or most of the low or average flow of the stream is diverted into fields or reservoirs (Takasaki *et al*. 1969; Harris *et al*. 1993). By the 1930s, major water diversions had been developed on all the major islands and currently one third of Hawaii's perennial streams are diverted (Hawaii Stream Assessment 1990).

In addition to diverting water for agriculture and domestic water supply, streams have also been diverted for use in hydroelectric power. There are currently 18 active hydroelectric plants operating on Hawaiian streams, with an additional site proposed for construction, and another 28 sites identified for potential development (Hawaii Stream Assessment 1990; Gordon Smith, USFWS, pers. comm. 2004).

In addition to diverting surface flow in the stream channels, the perched aquifers which feed the streams have also been tapped by means of tunnels (Stearns and Vaksvik 1935; Stearns 1985). For example, both the bore tunnels and the contour tunnel of the Waiahole Ditch system pierced perched aquifers which were drained to the level of the tunnels (Stearns and Vaksvik 1935). Many of these aquifers were also the sources of springs which contributed flow to the windward streams. The draining of these aquifers caused many of the springs to dry up, including some over 0.5 kilometer (0.3 mile) away from the bore tunnels (Stearns and

Vaksvik 1935).

In addition to the loss of streams, most remaining streams have undergone and continue to be seriously degraded. Stream degradation has been particularly severe on the island of Oahu, where, in 1978, 57 percent of the perennial streams had been channelized (lined, partially lined or altered stream course) and 89 percent of the total length of these streams were channelized (Parrish *et al.* 1984). Channelization of streams has not been restricted to lower reaches. The channelization process results in removal of riparian vegetation, increased velocity, increased illumination, and higher water temperatures

Although some control of California grass is occurring on refuges, no conservation measures have been taken to address these threats where the oceanic Hawaiian damselfly occur.

B. Over-utilization for commercial, recreational, scientific, or educational purposes.
We are unaware of any current threats to this species resulting from over-utilization.

C. Disease or predation.
Similar to the aquatic insects, Hawaii has a depauperate freshwater fish fauna with only five native species comprised of gobies (Gobiidae) and sleepers (Eleotridae) that occur on all the major islands. Information on these five species indicates that the Hawaiian damselflies probably experienced limited natural predation pressure from the native fishes. Conversely, fish predation has been an important factor in the evolution of behavior in damselfly naiads in continental systems (Johnson 1991). Some species of damselflies, including the native Hawaiian species, are not adapted to cohabitate with some fish species, and are found only in bodies of water without fish (Henrickson 1988; McPeek 1990a). The naiads of these species tend to occupy more exposed positions and engage in conspicuous foraging behavior, thereby being susceptible to fish (Macan 1977; McPeek 1990b). Hawaiian damselflies evolved with few, if any predatory fish, and the exposed behavior of most of the fully aquatic species, makes them particularly vulnerable to predation by nonnative fish introductions.

Over 70 species of fish have been introduced into Hawaiian freshwater habitats, (Devick 1991; Staples and Cowie 2001; Englund 2004). The impact of fish introductions prior to 1900 cannot be assessed because this predated the initial collection of damselflies in Hawaii (Perkins 1913). In 1905, two species, the mosquito fish (*Gambusia affinis*) and the sailfin molly (*Poecilia latipinna*), were successfully introduced for biological control of mosquitoes (Van Dine 1907). In 1922, three additional species were established for mosquito control, the green swordtail (*Xiphophorus helleri*), the moonfish (*Xiphophorus maculatus*) and the guppy (*Poecilia reticulata*). The introduction of these species has been implicated in the extirpation of the Pacific Hawaiian damselfly (*Megalagrion pacificum*) from most of the main islands (Moore and Gagne 1982), and by 1935 on Oahu, the orangeblack Hawaiian damselfly (*Megalagrion xanthomelas*) was found only in waters without these introduced fish (Williams 1936; Zimmerman 1948a, Polhemus 1993; Englund 1998). Most of the fish introduced early into Hawaii are now established on all the major islands, and are primarily pond and reservoir inhabitants.

Beginning in about 1980, a large number of new fish introductions began in Hawaii, originating primarily from the aquarium fish trade (Devick 1991). By 1990, an additional 15 species of fish were established in waters on Oahu, including catfish, cichlids, gobies, top minnows, and needlefish, many of which readily invaded stream systems. By early 1990, the lower to middle reaches of two widely separated streams on Oahu, Manoa on the south leeward side, and Kaukonahua on the north windward side, were choked with dense populations of armored catfish (*Hypostomus* sp. and *Pterygoplichthys multiradiatus*) (Devick 1991). This recent wave of fish introductions on Oahu corresponded with the drastic decline and range reduction of the crimson Hawaiian damselfly (*Megalagrion leptodemas*), the oceanic Hawaiian damselfly, and the blackline Hawaiian damselfly (*Megalagrion nigrohamatum nigrolineatum*). Currently, these damselflies occur only in drainages or higher parts of stream systems where nonnative fish are not yet established (Englund and Polhemus 1994; Englund 2004). Some Hawaiian damselfly species are now reduced to a habitat less than 95 meters in length and which lacks invasive fish species (Englund 2004). The continued introduction and establishment of new species of nonnative fish, and the movement of established species to new drainages (Richard Brock, University of Hawaii, pers. comm. 1994) presents the greatest threat to this Hawaiian damselfly species.

Backswimmers are aquatic true bugs (Heteroptera) in the family Notonectidae, so called because they swim upside down. Backswimmers are voracious predators and frequently feed on prey much larger than themselves, tadpoles, small fish, and other aquatic insects including damselfly naiads (Borror *et al*. 1989). Backswimmers are not native to Hawaii, but several species have been introduced in recent times. *Buenoa pallipes* (Fabricus) (no common name) has been known from Hawaii since 1900 (Zimmerman 1948c) and has been recorded from all the major islands except Lanai (Nishida 1994). This species can be abundant in lowland ponds and reservoirs and feeds on any suitably sized insect, including damselfly naiads. More recently, two additional species of backswimmers have become established in Hawaii (Polhemus 1995). *Anisops kuroiwae* was first collected in 1991 and is known only from Maui. *Notonecta indica* was first collected on Oahu in the mid 1980s and is presently known from Maui and Hawaii. Species of *Notonecta* are known to prey on damselfly naiads and the mere presence of this predator in the water can cause naiads to reduce foraging (Heads 1985) which can reduce growth, development, and survival (Heads 1986). Backswimmers pose a threat to all populations of all Hawaiian stream-dwelling damselfly species.

Another nonnative aquatic insect group, the Trichoptera, (or caddisflies), has recently expanded its number of species and range throughout the Hawaiian Islands. As of 2001 a fourth species from this nonnative group appeared in the islands (Flint *et al*. 2003). It is suspected that the introduced caddisflies are adversely impacting native aquatic invertebrate populations either through competition for space and resources, or due to the caddisflies' large body size and sheer abundance in Hawaiian streams (Flint *et al*. 2003). In recent surveys of upper elevation Kauai streams for example, one caddisfly species accounted for 57 percent of the biota collected in the streams (Englund *et al*. 2000). Caddisflies now inhabit all of the 57 perennial streams on the island of Oahu (Flint *et al*. 2003).

Predation from introduced crustaceans and possibly nonnative birds such as bulbuls,

cardinals and mynas may also pose a threat to all life phases of the oceanic Hawaiian damselfly (D. Preston, Bishop Museum, pers. comm. 2005).

No conservation measures have been taken to address these threats for this species.

D. The inadequacy of existing regulatory mechanisms.
The State of Hawaii considers all natural flowing surface water (streams, springs and seeps) as State property (Hawaii Revised Statutes 174c 1987), and the Hawaii Department of Land And Natural Resources has management responsibility for the aquatic organisms in these waters (B. Devick, pers. comm. 1995). Thus, damselfly populations associated with streams, seeps and springs are under the jurisdiction of the State of Hawaii, regardless of the ownership of the property across which the stream flows. This includes all populations of the crimson Hawaiian damselfly, the blackline Hawaiian damselfly, and the oceanic Hawaiian damselfly, as well as some populations of the Pacific Hawaiian damselfly and the orangeblack Hawaiian damselfly occurring in streams.

State regulatory mechanisms currently in effect do not provide adequate protection for native Hawaiian damselflies or their habitat. The State of Hawaii has not listed these damselflies as endangered or threatened and so does not afforded them any protection under the State endangered species act. Nor does the State Water Code afford adequate protection from the adverse effects of water development projects. The State of Hawaii manages the use of surface and ground water resources through the Commission on Water Resource Management (Water Commission), as mandated by the 1987 State Water Code (State Water Code, Hawaii Revised Statutes Chapter 174C-71, 174C-81-87, and 174C-9195 and Administrative Rules of the State Water Code, Title 13, Chapters 168 and 169). In the State Water Code, there are no formal requirements that project proponents or the Water Commission protect the habitats of fish and wildlife prior to issuance of a permit to modify surface or ground water resources.

The maintenance of instream flow, which is required to protect the habitat of damselflies and other aquatic wildlife, is regulated by the establishment of standards on a stream-by-stream basis (State Water Code, Hawaii Revised Statutes Chapter 174C-71 and Administrative Rules of the State Water Code, Title 13, Chapter 169). Currently, the interim instream flow standards represent the existing flow conditions in streams in the State as of 15 June 1988 for Molokai, Hawaii, Kauai and east Maui, and 19 October 1988 for west Maui and leeward Oahu (Administrative Rules of the State Water Code, Title 13, Chapter 169-44-49). However, the State Water Code does not provide for permanent or minimal instream flow standards for the protection of aquatic wildlife. Instead, modification of instream flow standards and stream channels can be undertaken at any time by the Water Commission or via public petitions to revise flow standards or modify stream channels in a specified stream (Administrative Rules of the State Water Code, Title 13, Chapter 169-36). Additionally, the Water Commission must consider economic benefits gained from out-of-stream water uses, and is not required to balance these benefits against instream benefits to aquatic fish and wildlife. Consequently, any stabilization of stream flow for the protection of Hawaiian damselfly habitat is subject to modification at a future date.

The natural value of Hawaii's stream systems have been recognized under the State of Hawaii Instream Use Protection Program (Administrative Rules of the State Water Code, Title 13, Chapter 169-20(2)). In the Hawaii Stream Assessment Report (1990), prepared in coordination with the National Park Service, the State Water Commission identified high quality rivers or streams, or portions of rivers or streams that may be placed within a wild and scenic river system. This report recommended that streams meeting certain criteria be protected from further development. However, there is no formal or institutional mechanism within the Water Code to designate and set aside these streams, or to identify and protect stream habitat for Hawaiian damselflies.

Existing Federal regulatory mechanisms that may protect Hawaiian damselflies and their habitat are also inadequate. The Federal Energy Regulatory Commission (FERC) has very limited jurisdiction in Hawaii. Hydroelectric power projects in Hawaii are not on navigable water, public lands, or United States reservations; do not use surplus water or water power from a Federal government dam; and do not affect the interests of interstate or foreign commerce. Thus, licensing of hydroelectric projects do not come under the purview of FERC. However, hydropower developers in Hawaii may voluntarily seek licensing under FERC.

The U.S. Army Corps of Engineers (COE) also has some regulatory control over modifications of freshwater streams in the United States. For modifications (i.e., discharge of fill) of streams with an average annual flow greater than 5 cubic feet per second (cfs), the COE can issue individual permits under section 404 of the Clean Water Act. These permits are subject to public review, and must comply with the Environmental Protection Agency's 404(b)(1) guidelines and public comment requirements. However, in issuing these permits, the COE does not establish instream flow standards as a matter of policy. The COE normally considers that the public interest for instream flow is represented by the state water allocation rights or preferences (Regulatory Guidance Letter No 85-6), and project alternatives that supersede, abrogate, or otherwise impair the state water quantity allocations are not normally addressed as alternatives during permit review.

In cases where the COE district engineer does propose to impose instream flow standard on an individual permit, this flow standard must reflect a substantial national interest. Additionally, if this instream flow standard is in conflict with a State water quantity allocation, then it must be reviewed and approved by the Office of the Chief Engineer in Washington, D.C. Currently, the setting of instream flow standards sufficient to conserve Hawaiian damselflies is not a condition that would be considered or included in an individual permit.

The COE may also authorize the discharge of fill into streams with an average annual flow of less than 5 cfs. These discharges are covered under a nationwide permit (33 CFR 330 Appendix A, Nationwide Permit 26). This permit is designed to expedite small scale activities that the COE considers to have only minimal environmental impacts (33 CFR 330.1(b)). The USFWS and State Department of Land and Natural Resources have only 15

days to provide substantive site-specific comments prior to the issuance of a nationwide permit (33 CFR 330 Appendix A, Nationwide Permit Condition 13). Given the complexity of the impacts on Hawaiian damselflies from stream modifications and surface water diversions, the remoteness of project sites, and the types of studies necessary to determine project impacts and mitigation, this limited comment period does not allow for an adequate assessment of impacts.

E. Other natural or manmade factors affecting its continued existence.
Even if the threats responsible for the decline of this species were controlled, the persistence of existing populations is hampered by the small number of extant populations and the small geographic range of the known populations. This circumstance makes the species more vulnerable to extinction due to a variety of natural processes. Small populations are particularly vulnerable to reduced reproductive vigor caused by inbreeding depression, and they may suffer a loss of genetic variability over time due to random genetic drift, resulting in decreased evolutionary potential and ability to cope with environmental change (Lande 1988: Center for Conservation Update 1994). Small populations are also demographically vulnerable to extinction caused by random fluctuations in population size and sex ratio and to catastrophes such as hurricanes, landslides, and flashfloods (Lande 1988; D. Preston, Bishop Museum, pers. comm. 2005). No conservation measures have been taken to address these threats for this species.

RECOMMENDED CONSERVATION MEASURES
Translocation efforts of the orangeblack damselfly were initiated again in July 2003. It is hoped that information gained from these efforts can then be applied in the conservation of other damselflies, including the Oceanic Hawaiian damselfly. In addition, we are looking into getting State approval in the use of a pesticide for the renovation and recovery of streams and other bodies of water that contain nonnative fish.

SUMMARY OF THREATS
The greatest threats to the oceanic Hawaiian damselfly are loss of suitable habitat and predatory nonnative fish. There are no efforts being undertaken to address these threats for this species.

LISTING PRIORITY:

THREAT			
Magnitude	Immediacy	Taxonomy	Priority
High	**Imminent**	Monotypic genus	1
		Species	**2 ***
		Subspecies/population	3
	Non-imminent	Monotypic genus	4
		Species	5
		Subspecies/population	6

Moderate to Low	Imminent	Monotypic genus	7
		Species	8
		Subspecies/population	9
	Non-imminent	Monotypic genus	10
		Species	11
		Subspecies/population	12

Yes Have you promptly reviewed all of the information received regarding the species for the purpose of determining whether emergency listing is needed?

Rationale for listing priority number:
Magnitude:

This species is highly threatened throughout its limited range by habitat loss and by predation from introduced nonnative fish. These threats occur range-wide and there are no efforts being done to control or eradicate nonnative fish or to stop the loss of habitat.

Imminence:

Threats to the oceanic Hawaiian damselfly from loss of habitat and introduced nonnative fish are considered imminent because they are on-going.

Have you promptly reviewed all of the information received regarding the species for the purpose of determining whether emergency listing is needed? yes

Is Emergency Listing Warranted? No. The species does not appear to be appropriate for emergency listing at this time because the immediacy of the threats is not so great as to imperil a significant proportion of the taxon within the time frame of the routine listing process. If it becomes apparent that the routine listing process is not sufficient to prevent large losses that may result in this species' extinction, then the emergency rule process for this species will be initiated. We will continue to monitor the status of the oceanic Hawaiian damselfly as new information becomes available. This review will determine if a change in status is warranted, including the need to make prompt use of emergency listing procedures.

DESCRIPTION OF MONITORING
We conducted literature searches for recent articles on this species and contacted relevant species experts, U.S. Geological Survey-Biological Resources Discpline, U.S. Army, State officials with the Department of Land and Natural Resources, and Bishop Museum, University of Hawaii, and National Museum of Natural History researchers regarding the current status of this species.

This level of monitoring is appropriate to update the status of the species because a thorough literature search was conducted as well as relevant species experts contacted. Information contained in this assessment form was verified and any updated information incorporated. The Hawaii Biodiversity and Mapping Program lists this subspecies as imperiled (Hawaii Biodiversity and Mapping Program database 2004). This species is not listed in the International Union for Conservation of Nature and Natural Resources Red Data List database (International

Union for Conservation of Nature and Natural Resources database 2004).

List of Experts Contacted:

Name	Date	Place of Employment
Adam Asquith	July 12, 2005	University of Hawaii
Vince Costello	July 13, 2005	U.S. Army
Ronald Englund	July 12, 2005	Bishop Museum
David Foote	July 12, 2005	U.S. Geological Survey, BRD
Betsy Gagne	July 12, 2005	Hawaii Dept of Land and Natural Resources
Michael Kido	July 12, 2005	University of Hawaii
Robert Nishimoto	July 13, 2005	Hawaii Dept of Land and Natural Resources
David Preston	July 12, 2005	Bishop Museum
Dan Polhemus	July 12, 2005	National Museum of Natural History

List of Databases Searched:

Name	Date
Hawaii Biodiversity and Mapping Program	2004
International Union for Conservation of Nature and Natural Resources database	2004

COORDINATION WITH STATES

In October 2004 we provided the Division of Forestry and Wildlife Administrator, Paul Conry, with copies of our most recent candidate assessment forms for his review and comment. In addition, copies of the candidate forms were sent to Betsy Gagne, Executive Secretary for the Hawaii Natural Area Reserves System Commission. Ms. Gagne reviewed the information for this species and provided no additional information or corrections (B. Gagne, pers. comm. 2005).

LITERATURE CITED

Allen, C. R., S. Demarais, and R. S. Lutz. 1994. Red imported fire ant impact on wildlife: an overview. Texas Journal of Science 46:51-9.

Asquith, A. 1995. Hawaiian Damselfly Survey: Population Checklist of Category 1 Candidate Species. Unpublished Document by U.S. Fish & Wildlife Service, Pacific Islands Office, Honolulu, HI.

Asquith, A. and D. Polhemus. 1996. Hawaiian Damselflies: A Field Identification Guide. Bishop Museum Press. Honolulu. 122pp.

Beardsley, J.W. 1962. On accidental immigration and establishment of terrestrial arthropods in Hawaii during recent years. Proc.Hawaii. Entomol. Soc. 18:99-109.

Beardsley, J.W. 1979. New immigrant insects in Hawaii: 1962 through 1976. Proc. Hawaii. Entomol. Soc. 23:35-44.

Borror, D.J., C.A. Triplehorn and N.F. Johnson. 1989. Introduction to the Study of Insects, Sixth Ed. Saunders College Publishing, Philadelphia.

Brinkley, C. K., R. T. Ervin, and W. L. Sterling. 1991. Potential beneficial impact of red imported fire ant to Texas cotton production. Biological Agricultural Horticulture 8:145-52.

Center for Conservation Biology. 1994. Nectar, fecundity and conservation planning. Center for Conservation Biology Update, Vol. 8(1): 10 (summer).

Devick, W.S. 1991. Patterns of introduction of aquatic organisms to Hawaiian freshwater habitats: *in* Devick, W.S., New Direction in Research, Management and Conservation of Hawaiian Freshwater Stream Ecosystems, Proceedings of the 1990 Symposium on Freshwater Stream Biology and Fisheries Management, Dep. Land Nat. Resource., Honolulu, Hawaii.

Englund, R.A. 1998. New records and range extensions of native Odonata (Coenagrionidae) and introduced aquatic species in the Hawaiian Islands. Bishop Museum Occasional Papers. 59: 15-16.

Englund, R. A. 2004. Assessing the spectrum of threats: impacts of invasive freshwater fish species on native Hawaiian aquatic insects. Abstract for 2004 Hawaii Conservation Conference.

Englund, R. and D.A. Polhemus. 1994. Maakua Stream biological assessment, Oahu, Hawaii. Environmental Technologies International, Honolulu, Hawaii.

Englund, R. A., D. A. Polhemus, and D. J. Preston. 2000. Assessment of the impacts of rainbow trout predation on native aquatic invertebrate species within Kokee State Park streams, Kauai, Hawaii. Bishop Museum Technical Report 18, 125 p.

Ericson, Terrell. 2004. U.S. Department of Agriculture. Honolulu, Hawaii. Personal communication.

Flint, O. S., R. A. Englund, and B. R. Kumashiro. 2003. A reassessment and new State records of Trichoptera occurring in Hawaii with discussion on origins and potential ecological impacts. Bishop Museum Occasional Papers 73: 31-40.

Funasaki, G.Y., P.L. Lai, L.M. Nakahara, J.W. Beardsley & A.K. Ota. 1988. A review of biological control introductions in Hawaii: 1890 to 1985. Proc. Hawaii. Entomol. Soc. 28:105-160.

Gillespie, R.G. and N. Reimer. 1993. The effect of non-native predatory ants (Hymenoptera: Formicidae) on Hawaiian endemic spiders (Araneae: Tetragnathidae). Pacific Sci. 47:21-33.

Handy, E.S.C. and E.G. Handy. 1972. Native planters in old Hawaii. Their life, lore, and

environment. B.P. Bishop Mus. Bull. 233:1-641.

Hardy, D.E. 1979. An ecological survey of Puaaluu Stream. Part III. Report on a preliminary entomological survey of Puaaluu Stream, Maui. Coop. Nat. Park Resources Study Unit. University of Hawaii. Technical Report 27: 34-39.

Harris, S., A. Rubissow, S. Edmunds, and J.A. Cachola. 1993. Hawaii Streams. Document prepared for Commission on Water Resource Management, State of Hawaii. 40 pp.

Hawaii Ant (Working) Group. 2001. A plan for prevention of establishment of new ant species in Hawaii, with special attention to the red imported fire ant (Solenopsis invicta). Report to the Hawaii Coordinating Group on Alien Pest Species, October 22, 2001. 13pp.

Hawaii Stream Assessment. 1990. Department of Land and Natural Resources, State of Hawaii. 300 pp.

Heads, P.A. 1985. The effect of invertebrate and vertebrate predators on the foraging movements of *Ischnura elegans* larvae (Odonata: Zygoptera). Freshw. Biol. 15:559-571.

Heads, P.A. 1986. The costs of reduced feeding due to predator avoidance: potential effects on growth and fitness in *Ischnura elegans* larvae (Odonata: Zygoptera). Ecol. Entomol. 11:369-377.

Henrikson, B.I. 1988. The absence of antipredator behavior in the larvae of *Leucorrhinia dubia* (Odonata) and the consequences for their distribution. Oikos 51: 179-183.

Howarth, F.G. 1990. Hawaiian terrestrial arthropods: An overview. Bishop. Mus. Occas. Pap. 30:4-26.

Howarth, F.G. and A.C. Medeiros. 1989. Non-native invertebrates: *in* Stone, C.P. and D.B. Stone (Eds.), Conservation Biology in Hawaii. Univ. Hawaii Coop. Natl. Park Resource. Stud. Unit, Honolulu. Pp. 82-87.

Howarth, F.G. and G.W. Ramsay. 1991. The conservation of island insects and their habitats: *in* Collins, N.M. and J.A. Thomas (Eds.), The Conservation of Insects and Their Habitats, Academic Press, London. pp. 71-107

Howarth, F.G., A. Asquith, and G. Nishida. 1994. Insect of Hawaii: Status and Trends. Unpublished manuscript.

Jetter, K. M., J. Hamilton, and J. H. Klotz. 2002. Red imported fire ants threaten agriculture, wildlife, and homes. California Agriculture 56, 1: 26-34.

Johnson, D.M. 1991. Behavioral ecology of larval dragonflies and damselflies. Trends Ecol. Evol. 6:8-13.

Kirch, P.V. 1982. The impact of the prehistoric Polynesians on the Hawaiian ecosystem. Pacific Sci. 36:1-14.

Lai, P.Y. 1988. Biological control: A positive point of view. Proc. Hawaii. Entomol. Soc. 28:179-190.

Lande, R. 1988. Genetics and demography in biological conservation. Science 241:1455- 1460.

Macan, T.T. 1977. The influence of predation on the composition of freshwater animal communities. Biol. Rev. 52:45-70.

McLachlan, R. 1883. Neuroptera of the Hawaiian Islands. - Part I. Pseudo-Neuroptera. Ann. Mag. Nat. Hist., (V) 12: 226-240: *in* Zimmerman, E.C. 1948. Insects of Hawaii, Vol. 2. Apterygota - Thysanoptera. University of Hawaii Press, Honolulu.

McPeek, M.A. 1990a. Determination of species composition in the *Enallagma* damselfly assemblages of permanent lakes. Ecol. 71:83-98.

McPeek, M.A. 1990b. Behavioral differences between *Enallagma* species (Odonata) influencing differential vulnerability to predators. Ecol. 71:1714-1726.

Meier, K.Z., J.P. Laurel and J.E. Maragos. 1993. State of Hawaii (USA): *in* Scott, D.A., A Directory of Wetlands in Oceania, The International Waterfowl and Wetlands Research Bureau, U.K., and Asia Wetland Bureau, Kuala Lumpur, Malaysia. 444 pp.

Moore, N.W. and W.C. Gagne. 1982. *Megalagrion pacificum* (McLachlan) - A preliminary study of the conservation requirements of an endangered species. Rep. Odon. Specialist group Int. Un. Conserv. Nat. Natur. Res. No 3:1-5.

Nafus, D.M. 1993a. Biological control agents and native parasitoids in the population system of the butterfly *Hypolimnas bolinas* (L.) (Lepidoptera: Nymphalidae). Micronesica, Suppl. 4:17-23.

Nafus, D. M. 1993b. Extinction, biological control, and insect conservation on islands. Pp. 139-154: In: Gaston, K. J., TR. New, and M. J. Samways (eds.) Perspectives on Insect Conservation. Intercept Ltd., Andover, UK.

Nishida, G.M., (Ed.) 1994. Hawaiian Terrestrial Arthropod Checklist, 2nd Ed. Bishop. Mus. Tech. Rep. No. [1]. 287 pp.

O'Connor, P.J. 1990. Poaceae: *in* W.L. Wagner, D.R. Herbst and S. Sohmer (Eds.), Manual of the Flowering Plants of Hawaii. B.P. Bishop Mus. Spec. Publ. No. 83. 1853 pp.

Parrish, J.D., J.A. Maciolek, A.S. Timbol, C.B. Hathaway, and S.E. Norton. 1984. Status of

stream channel modification in Hawaii and its effects on native aquatic fauna. Pp. 83-84. Proc. 5th Conference in Natural Sciences, Hawaii, Volcanoes National Park. Coop. Natl. Park. Res. Stud. Unit, Univ. Hawaii.

Perkins, R.C.L. 1913. Introduction to Fauna Hawaiiensis. D. Sharp, (Ed.), Vol. 1:xv-ccxxvii. Cambridge Univ. Press, Cambridge.

Polhemus, D.A. 1993. Conservation of aquatic insects: Worldwide crisis or localized threats? Amer. Zool. 33:588-598.

Polhemus, D.A. 1994a. A revision of the Hawaiian damselflies in the genus *Megalagrion* (Odonata: Coenagrionidae). Unpublished report to U.S. Fish & Wildlife Service, Pacific Islands Office.

Polhemus, D.A. 1994b. Current status of *Megalagrion* populations on Oahu: 1990 - Present. Report to U.S. Fish & Wildlife Service, Pacific Islands Office.

Polhemus, D.A. 1995. New Heteroptera and Odonata (Insecta) records and range extensions in the Hawaiian Islands. Bishop Mus. Occas. Pap. 42:42-43.

Reimer, N.J. 1993. Distribution and impact of non-native ants in vulnerable Hawaiian ecosystems: *in* D.F.Williams (Ed.), Exotic Ants: Biology, Impact, and Control of Introduced Species. Westview Press, Boulder, Colorado. Pp. 11-22.

Reimer, N., J.W. Beardsley and G. Jahn. 1990. Pest ants in Hawaii: *in* Vander Meer, R.K, K. Jaffe and A. Cedeno (Eds.), Applied Myrmecology: A World Perspective. Westview Press, Boulder, Colorado, Pp. 40-50.

Smith, C.W. 1985. Impact of non-native plants on Hawaii's native biota: *in* C.P.Stone and J.M. Scott (Eds.), Hawaii's Terrestrial Ecosystems: Preservation and Management. Coop. National Park Resource. Study Unit, Univ. Hawaii, Honolulu.

Smith, Gordon. 2004. U. S. Fish and Wildlife Service. Honolulu, Hawaii. Personal communication.

Staples, G. W. and R. H. Cowie (Eds.) 2001. Hawaii's Invasive Species. Mutual Publishing and Bishop Museum Press. Honolulu, HI. 111p.

Stearns, H.T. 1985. Geology of the State of Hawaii. second edition. Pacific Books, Palo Alto, California.

Stearns, H.T. and K.N. Vaksvik. 1935. Geology and ground-water resources of the island of Oahu, Hawaii. Bulletin 1 of the Division of Hydrography, Territory of Hawaii.

Stone, C.P. 1989. Hawaii's wetlands, streams, fishponds, and pools: *in* C.P.Stone and D.B. Stone

(Eds.), Conservation Biology in Hawaii. Coop. Natl. Park Resource. Study Unit, Univ. Hawaii, Honolulu. Pp. 125-136.

Summers, C.C. 1964. Hawaiian Fishponds. B.P. Bish. Mus. Spec. Publ. 52.

Takasaki, K.I., G.T. Hirashima, and E.R. Lubke. 1969. Water Resources of Windward Oahu, Hawaii. U.S. Geological Survey Water Supply Paper No. 1894:1-119. U.S. Gov. Printing Office, Washington, D.C.

U.S. Fish and Wildlife Service. 1985. Recovery plan for the Hawaiian waterbirds. U.S. Fish Wildl. Serv., Portland, Oregon. 99 pp.

U.S. Fish and Wildlife Service. 1995. Pacific Islands Ecoregion Coastal Ecosystems Program Proposal. U.S. Fish Wildl. Serv., Honolulu, Hawaii, 119 pp.

Van Dine, D.L. 1907. The introduction of top-minnows (natural enemies of mosquitoes) into the Hawaiian Islands. Haw. Agr. Exp. St. Press Bull. 20:1-10.

Williams, F.X. 1936. Biological studies in Hawaiian water-loving insects. Part 1. Coleptera or beetles. Part 2. Odonata or dragonflies. Proc. Hawaii. Entomol. Soc. 9:235-345.

Wilson, Okamoto and Associates, Inc. 1993. Kawai Nui Marsh Master Plan: Development Project Report. Document prepared for Dep. Land and Natural Resources., State of Hawaii.

Wong, T. T., D. O. McInnis, J. I. Nishimoto, A. K. Ota, and V. C. S. Chang. 1984. Predation of the Mediterranean fruit fly (Diptera: Tephritidae) by the Argentine ant (Hymenoptera: Formicidae) in Hawaii. J. Econ. Entomol. 77: 1454-1458.

Wong, M.A. and T.T.Y. Wong. 1988. Predation of the Mediterranean fruit fly and oriental fruit fly (Diptera: Tephritidae) by the fire ant (Hymenoptera: Formicidae) in Hawaii. Proc. Hawaii. Entomol. Soc. 28:169-177.

Zimmerman, E. C. 1941. Argentine ant in Hawaii. Proc. Hawaii. Entomol. Soc. 11: 108.

Zimmerman, E.C. 1948a. Insects of Hawaii, Vol. 2. Apterygota - Thysanoptera. Univ. Hawaii Press, Honolulu.

Zimmerman, E.C. 1948b. Insects of Hawaii. Vol. 1. Introduction. xvii + 206pp. Univ. Hawaii Press, Honolulu.

Zimmerman, E.C. 1948c. Insects of Hawaii, Vol. 3. Heteroptera. Univ. Hawaii Press, Honolulu.

Zimmerman, E. C. 1958. Macrolepidoptera. Insects of Hawaii. Vol. 7. University of Hawaii Press, Honolulu.

APPROVAL/CONCURRENCE: Lead Regions must obtain written concurrence from all other Regions within the range of the species before recommending changes including elevations or removals from candidate status and listing priority changes; the Regional Director must approve all such recommendations. The Director must concur on all resubmitted 12-month petition findings, additions or removal of species from candidate status, and listing priority changes.

Approve: Acting _____ 11/10/05
Regional Director, Fish and Wildlife Service Date

_____

Concur: _____ August 23, 2006
Director, Fish and Wildlife Service Date

Do not concur: _____ _____
Director, Fish and Wildlife Service Date

Date of annual review: 8/4/05

Conducted by: Lorena Wada, Pacific Islands FWO

Comments:

PIFWO Review
Reviewed by: Gina Shultz Date: 10/12/05
Assistant Field Supervisor, Endangered Species

Patrick Leonard Date: 10/11/05
Field Supervisor